

KNOWLEDGE AND ATTITUDE REGARDING STERILIZATION AND DISINFECTION AMONG NON-SURGICAL STUDENTS AT KMU INSTITUTE OF HEALTH SCIENCES KURRAM: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background

Healthcare-associated infections (HAIs) remain a major challenge to patient safety and healthcare quality worldwide. Proper sterilization and disinfection practices are essential for preventing infection transmission in healthcare settings. Non-surgical healthcare students frequently interact with patients and clinical environments; therefore, adequate knowledge and positive attitudes regarding infection prevention are important.

Objective

To assess the knowledge and attitudes regarding sterilization and disinfection among non-surgical students at KMU Institute of Health Sciences Kurram.

Methods

A descriptive cross-sectional study was conducted among 384 non-surgical students at KMU-IHS Kurram, Pakistan. Participants were selected through simple random sampling. Data were collected using a structured self-administered questionnaire consisting of socio-demographic characteristics, knowledge-related questions, and attitude statements regarding sterilization and disinfection. Data were analyzed using SPSS version 24 and presented as frequencies and percentages.

Results

Most participants were aged 21–25 years (59.9%), while males constituted 52.3% of the study population. More than half of the students (56.2%) had not received formal training regarding sterilization and disinfection. The majority correctly identified sterilization as elimination of all microorganisms including spores (67.2%), recognized autoclaving as a sterilization method (69.0%), and acknowledged the importance of personal protective equipment during sterilization procedures (78.4%). Positive attitudes toward infection prevention were also observed, with 46.4% strongly agreeing and 38.3% agreeing that proper sterilization prevents infections.

Conclusion

Non-surgical healthcare students demonstrated moderate knowledge and generally positive attitudes regarding sterilization and disinfection practices. However, important knowledge gaps and insufficient formal training were identified. Strengthening infection prevention education and practical infection control training is recommended to improve safe clinical practices among healthcare students.

Keywords

Sterilization; Disinfection; Infection Control; Healthcare Students; Knowledge; Attitude; Healthcare-Associated Infections

INTRODUCTION

Healthcare-associated infections (HAIs) are a major public health concern worldwide and significantly affect patient safety and quality of healthcare services. Inadequate sterilization and disinfection practices contribute substantially to the transmission of infectious pathogens within healthcare environments [1]. Sterilization refers to the complete elimination of all microorganisms including bacterial spores, while disinfection involves the elimination of most pathogenic microorganisms from surfaces and equipment [2]. Both practices are essential components of infection prevention and control (IPC). Healthcare students are regularly exposed to clinical environments during their academic training. Although surgical students often receive extensive practical instruction in sterilization procedures, non-surgical students may have limited exposure to infection control practices [3]. Insufficient knowledge and negative attitudes toward sterilization and disinfection can increase the risk of cross-contamination and compromise patient safety. Knowledge regarding sterilization includes understanding the principles, procedures, and importance of infection prevention methods. Attitude refers to beliefs, perceptions, and willingness to comply with infection control guidelines [4]. Previous studies have shown that inadequate knowledge and poor compliance with infection control measures among healthcare trainees contribute to increased healthcare-associated infections [5,6]. In developing countries such as Pakistan, infection prevention practices are often challenged by limited resources, inadequate training, and inconsistent institutional infection control policies [7]. Previous studies conducted in healthcare institutions in Pakistan have demonstrated variable awareness

levels among healthcare workers and students regarding infection prevention measures [8]. KMU Institute of Health Sciences Kurram is a healthcare educational institution that trains students from multiple allied health disciplines. These students participate in clinical training where adherence to sterilization and infection prevention protocols is necessary. However, limited evidence exists regarding the knowledge and attitudes of non-surgical healthcare students toward sterilization and disinfection practices in this region. Therefore, this study aimed to assess the knowledge and attitudes regarding sterilization and disinfection among non-surgical students at KMU Institute of Health Sciences Kurram.

Methodology

Study Design and Setting

A descriptive cross-sectional study was conducted at KMU Institute of Health Sciences (KMU-IHS), Parachinar, District Kurram, Khyber Pakhtunkhwa, Pakistan.

Study Population

The study included non-surgical students enrolled in various health science programs including Medical Laboratory Technology (MLT), Nursing, Health Sciences, Dental Technology, Anesthesia Technology, Emergency Care Technology, and Radiology.

Sample Size and Sampling Technique

The sample size was calculated using Cochran's formula:

$$n = p(1 - p) \left(\frac{Z}{e}\right)^2$$

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Using a 95% confidence interval and 5% margin of error, the calculated sample size was 384 participants. Simple random sampling was employed.

Inclusion Criteria

- Non-surgical students enrolled at KMU-IHS Kurram
- Students present during data collection

Exclusion Criteria

- Students from surgical programs
- Students absent during data collection
- First and second semester students
- Nutrition students

Data Collection Tool

Data were collected using a structured self-administered questionnaire divided into three sections:

1. Socio-demographic characteristics
2. Knowledge regarding sterilization and disinfection
3. Attitude toward sterilization and infection control

Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 24. Frequencies

and percentages were used to summarize findings.

Ethical Considerations

Institutional permission and ethical approval were obtained before data collection. Participation was voluntary, and confidentiality and anonymity were maintained throughout the study.

Results

Socio-Demographic Characteristics

A total of 384 students participated in the study. Most participants were aged 21–25 years (59.9%), while 25.5% were below 20 years and 14.6% were between 26–30 years. Male students constituted 52.3% of respondents.

Participants were enrolled in different health science disciplines, with the highest proportion from Medical Laboratory Technology (18.8%), followed by Nursing (16.9%) and Dental Technology (15.6%). More than half of the participants (56.2%) reported no formal training regarding sterilization and disinfection.

Table 1. Socio-Demographic Characteristics of Participants (n = 384)

Variable	Category	Frequency (n)	Percentage (%)
Age	<20 years	98	25.5
	21–25 years	230	59.9
	26–30 years	56	14.6
Gender	Male	201	52.3
	Female	183	47.7
Program	MLT	72	18.8
	Nursing	65	16.9
	Health Sciences	54	14.1
	Dental	60	15.6
	Anesthesia	48	12.5
	Emergency	45	11.7
	Radiology	40	10.4
Academic Semester	3rd–4th	146	38.0
	5th–6th	132	34.4
	7th–8th	106	27.6
Formal Training	Yes	168	43.8
	No	216	56.2

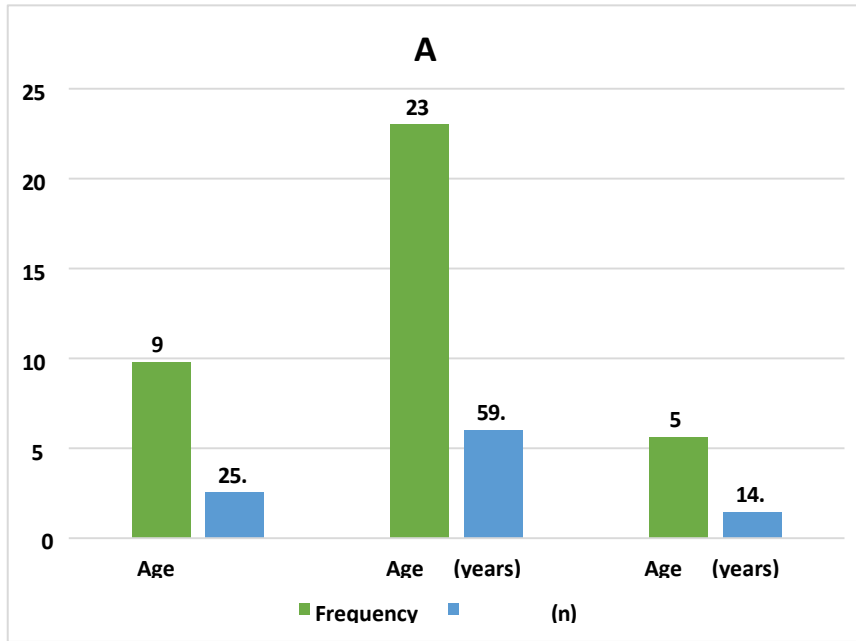


Figure 1. Age Distribution of Participants

Most participants belonged to the 21–25 years age group (59.9%), followed by students below 20 years (25.5%).

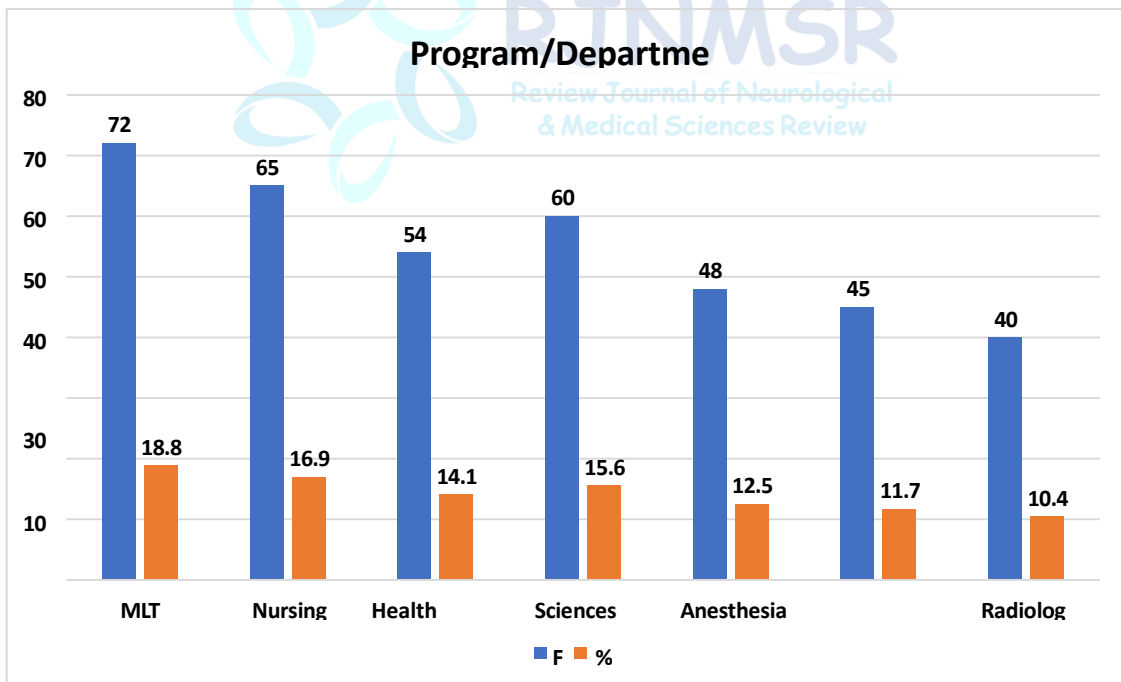


Figure 3. Program/Department of Participants

The highest proportion of students belonged to MLT (18.8%), followed by Nursing (16.9%) and Dental Technology (15.6%).

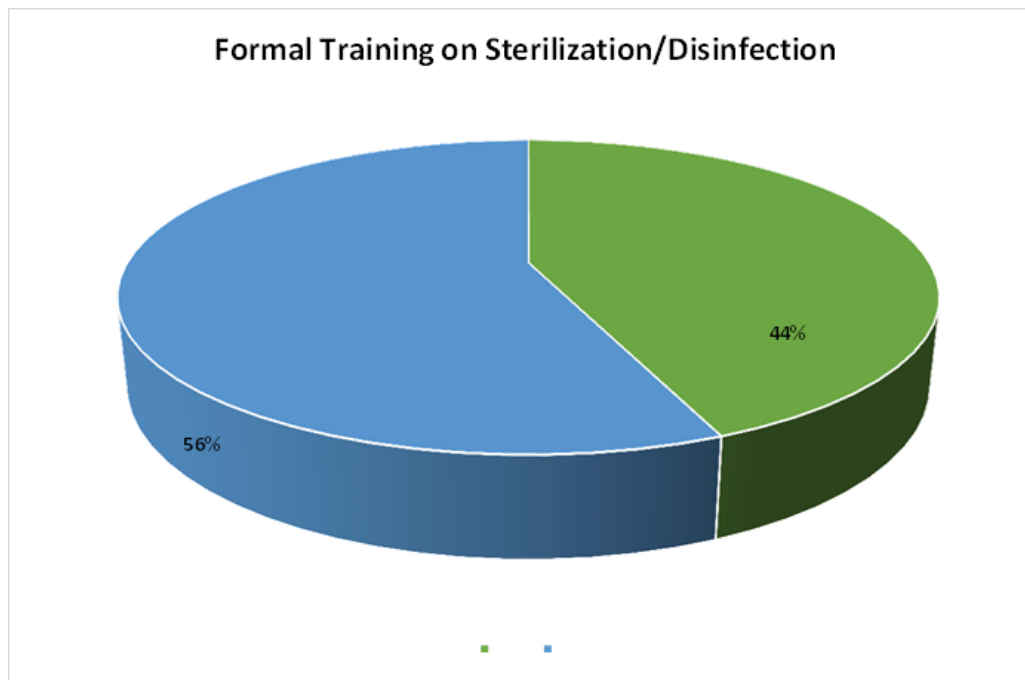


Figure 5. Formal Training on Sterilization and Disinfection

More than half of the students (56.2%) had not received formal infection control training.

Knowledge Regarding Sterilization and Disinfection

Most participants demonstrated moderate knowledge regarding sterilization and infection prevention practices. The majority correctly

identified sterilization as elimination of all microorganisms including spores (67.2%). Similarly, 69.0% correctly identified autoclaving as a sterilization method.

Knowledge regarding autoclave temperature was comparatively lower, with 57.0% correctly identifying 121°C as the standard autoclave temperature.

Table 2. Knowledge Regarding Sterilization and Disinfection (n = 384)

Question	Response	Frequency (n)	Percentage (%)
Sterilization eliminates	Some microorganisms	46	12.0
	All microorganisms including spores	258	67.2
	Only bacteria	52	13.5
	Don't know	28	7.3
Disinfection eliminates most microorganisms but not spores	Yes	236	61.5
	No	74	19.3
	Don't know	74	19.3
Disinfection is different from sterilization	Yes	248	64.6
	No	64	16.7
	Don't know	72	18.7
Autoclaving is a method of	Sterilization	265	69.0
	Disinfection	49	12.8
	Cleaning	33	8.6

	Don't know	37	9.6
Correct temperature for autoclave	100°C	56	14.6
	121°C	219	57.0
	150°C	39	10.2
	Don't know	70	18.2
PPE required during sterilization	Yes	301	78.4
	No	37	9.6
	Don't know	46	12.0

Attitude Toward Sterilization and Infection Control

Participants generally demonstrated positive attitudes toward sterilization and infection prevention. Nearly half of the respondents

(46.4%) strongly agreed that proper sterilization prevents infections, while 38.3% agreed. Similarly, 44.0% strongly agreed and 39.3% agreed that wearing PPE during sterilization procedures is necessary.

Table 3. Attitude Toward Sterilization and Infection Control (n = 384)

Statement	Response	Frequency (n)	Percentage (%)
Proper sterilization prevents infections	Strongly Agree	178	46.4
	Agree	147	38.3
	Neutral	35	9.1
	Disagree	17	4.4
	Strongly Disagree	7	1.8
Wearing PPE during sterilization is necessary	Strongly Agree	169	44.0
	Agree	151	39.3
	Neutral	34	8.9
	Disagree	21	5.5
	Strongly Disagree	9	2.3
Following sterilization protocols	Always	208	54.2
	Sometimes	126	32.8
	Rarely	35	9.1
	Never	15	3.9
Sterilized instruments properly labeled	Yes	206	53.6
	No	61	15.9
	Sometimes	117	30.5

Discussion

The present study assessed the knowledge and attitudes regarding sterilization and disinfection among non-surgical students at KMU Institute of Health Sciences (IHS) Kurram. Infection prevention and control are essential components of healthcare systems because healthcare-associated infections (HAIs) continue to contribute significantly to morbidity, mortality, prolonged hospitalization, and increased healthcare costs worldwide.

Sterilization and disinfection procedures play a critical role in reducing the transmission of infectious microorganisms in healthcare settings. Therefore, evaluating the awareness and attitudes of healthcare students toward these practices is important because these students eventually become frontline healthcare professionals responsible for patient safety.

The findings of this study demonstrated that most students possessed moderate knowledge

regarding sterilization and disinfection procedures. A considerable proportion of students correctly identified sterilization as the elimination of all microorganisms including spores, recognized autoclaving as a sterilization method, and understood the importance of using personal protective equipment (PPE) during sterilization procedures. These findings indicate that students have a foundational understanding of infection prevention principles despite belonging to non-surgical disciplines.

The results are comparable with previous studies conducted among healthcare students and dental trainees in different countries. Mohan et al. reported that undergraduate healthcare students generally demonstrated acceptable awareness regarding sterilization and infection control practices, particularly concerning the use of sterilization equipment and personal protective measures [9]. Similarly, Panta et al. found that healthcare workers and trainees in Nepal had moderate knowledge and positive attitudes toward sterilization and reuse of medical devices, although practical knowledge deficiencies remained evident [10]. The consistency between the present findings and earlier studies suggests that infection prevention education has become increasingly recognized within healthcare training programs.

Despite the moderate overall knowledge level observed in this study, important knowledge gaps were also identified. A substantial proportion of participants failed to correctly identify the standard autoclave temperature, while some students were unable to distinguish between sterilization and disinfection. These findings suggest incomplete understanding of technical sterilization parameters and infection prevention protocols. Similar deficiencies have been reported in previous studies among healthcare trainees in low- and middle-income countries, where infection prevention education is often affected by limited resources, insufficient practical exposure, and inconsistent institutional training policies [11,12].

One possible explanation for these knowledge gaps is the limited practical exposure received by non-surgical students during clinical training. Students in surgical and procedure-based disciplines generally receive more

extensive instruction regarding sterilization techniques, operation theater protocols, and instrument handling compared with non-surgical students. In contrast, non-surgical students may receive primarily theoretical education with fewer opportunities for hands-on infection control practice. Consequently, they may understand general concepts but lack detailed technical knowledge regarding sterilization procedures.

A particularly important finding of this study was that more than half of the participants reported not receiving formal training regarding sterilization and disinfection. This finding is concerning because inadequate formal infection control education may increase the likelihood of unsafe practices during clinical exposure. Infection prevention training is essential not only for protecting patients but also for reducing occupational risks among healthcare students and healthcare workers themselves. Exposure to blood-borne pathogens, contaminated equipment, respiratory infections, and cross-contamination hazards can place healthcare trainees at significant risk if proper infection control precautions are not followed.

The lack of formal training observed in this study may reflect broader educational challenges in developing healthcare systems where infection prevention modules are not sufficiently integrated into healthcare curricula. Similar findings have been documented in studies conducted in Pakistan and other developing countries, where healthcare students frequently demonstrate variable awareness regarding sterilization procedures due to inconsistent institutional emphasis on infection control education [7,8]. This emphasizes the need for structured and standardized infection prevention training programs across healthcare institutions.

The current findings can also be interpreted using the Knowledge-Attitude-Practice (KAP) model. According to this framework, knowledge influences attitudes, which subsequently affect behavior and professional practice. Students with better understanding of infection transmission and sterilization protocols are more likely to develop positive attitudes toward infection prevention and adhere to safety guidelines during clinical

practice. In the present study, students generally demonstrated positive attitudes toward sterilization and infection control, supporting the relationship proposed by the KAP model [14].

Most participants strongly agreed or agreed that proper sterilization is essential for preventing infections and recognized the importance of PPE during sterilization procedures. These positive attitudes are encouraging because attitude plays a major role in determining compliance with infection prevention protocols. Healthcare students who value infection prevention are more likely to follow sterilization guidelines, use PPE consistently, and maintain safe clinical behaviors during patient interactions.

The findings of positive attitudes observed in this study are consistent with previous research conducted among healthcare trainees. Azhar et al. reported that healthcare professionals and students generally demonstrated favorable attitudes toward infection prevention practices because they recognized their role in maintaining patient safety [15]. Similarly, studies among dental and nursing students have shown that awareness regarding cross-infection risks often contributes to improved compliance with sterilization protocols and standard precautions.

However, despite generally positive attitudes, the present study also identified concerns regarding consistency in infection control practices. Some students indicated that sterilization protocols were followed only sometimes, and others believed sterilized instruments were not always properly labeled. These responses may reflect gaps in institutional infection control monitoring, inadequate supervision during clinical training, or inconsistent implementation of sterilization protocols in healthcare settings.

These findings have important clinical implications. Healthcare students frequently participate in patient care during clinical placements, where improper sterilization and disinfection practices may contribute to healthcare-associated infections. Students who lack adequate practical knowledge regarding sterilization may unintentionally become sources of cross-contamination. Therefore, strengthening infection prevention

competencies among healthcare students is essential to improving patient safety outcomes and minimizing infection transmission risks.

The study also has significant educational implications. The findings strongly support the integration of comprehensive infection prevention and control modules into healthcare curricula for all disciplines, including non-surgical programs. Educational institutions should not limit infection control education to surgical students alone because all healthcare professionals encounter infectious risks in clinical environments.

Practical teaching approaches may significantly improve students' understanding and compliance with sterilization procedures. Simulation-based learning, hands-on demonstrations, laboratory sessions, workshops, and supervised clinical training can enhance both theoretical knowledge and practical competencies. Previous evidence suggests that structured educational interventions substantially improve infection prevention awareness and adherence to sterilization protocols among healthcare trainees.

Institutional and policy-related implications are also evident from this study. Healthcare education institutions should develop standardized infection prevention policies and ensure that students receive mandatory training before participating in clinical activities. Infection control education should be reinforced through continuous professional development programs, competency assessments, and regular monitoring of clinical practices.

In addition, healthcare administrators and policymakers should ensure the availability of adequate sterilization equipment, PPE supplies, and infection prevention resources within healthcare training institutions. Institutional support is essential because knowledge alone may not be sufficient if healthcare settings lack appropriate infection control infrastructure.

The present study contributes to the limited literature regarding infection prevention awareness among non-surgical healthcare students in Pakistan, particularly in peripheral regions such as Kurram. Most previous studies have focused primarily on doctors, nurses, surgical trainees, or dental professionals, while

non-surgical allied health students have received comparatively less attention. Therefore, this study provides valuable baseline data regarding the current level of awareness among students from multiple healthcare disciplines.

Although the study demonstrated moderate knowledge and positive attitudes overall, the existence of important knowledge gaps highlights the need for further educational improvement. Strengthening infection prevention education, increasing practical exposure, and improving institutional infection control policies may significantly enhance students' competencies and contribute to safer healthcare environments.

Conclusion

Non-surgical healthcare students at KMU-IHS Kurram demonstrated moderate knowledge and positive attitudes regarding sterilization and disinfection practices. However, important knowledge gaps and lack of formal training were identified.

Strengthening infection prevention education through practical training sessions, workshops, and structured infection control programs is necessary to improve students' competencies and promote safe clinical practices.

Recommendations

1. Comprehensive infection prevention and control training should be incorporated into curricula for all healthcare students.
2. Regular workshops and practical demonstrations regarding sterilization and disinfection should be conducted.
3. Educational institutions should promote awareness regarding infection prevention practices through seminars and continuous professional development activities.
4. Students should be encouraged to strictly follow infection control guidelines during clinical training.
5. Healthcare institutions should implement standardized sterilization and infection control policies.
6. Future multicenter studies should be conducted to compare awareness levels among different healthcare disciplines.

Strengths of the Study

- Inclusion of students from multiple health science disciplines
- Adequate sample size
- Structured assessment of both knowledge and attitudes
- Contribution to limited regional literature regarding infection prevention awareness

Limitations of the Study

- Single-center study limiting generalizability
- Cross-sectional design prevented assessment of long-term practices
- Self-reported responses may introduce reporting bias
- Surgical students were not included for comparison

REFERENCES

- Cheng HC, Chang YJ, Liao SR, Siewchaisakul P, Chen SL. The impact of COVID-19 on knowledge, attitude, and infection control behaviors among dentists. *BMC Oral Health*. 2021;21(1):584.
- Vishwakarma S, Singh A, Gupta N. Assessment of Knowledge and Attitude of Staff Regarding Hospital Acquired Infection in Gorakhpur, District Uttar Pradesh. *Int J Health Sci Res*. 2020;10(11):35-39.
- Shilpa-Jain DP, Santosh SS, Archana D, Smita S, Saumya-Rajesh P, Velmurugan N. Knowledge, attitude, and practice-based survey on instrument separation and its management among endodontists and postgraduates in India. *Saudi Endodontic Journal*. 2021;11(1):80-87.
- Parveen K, Parveen MK. Knowledge attitude and practices about endoscopy procedures among nurses of Nishtar Hospital Multan. *International Journal of Health, Medicine and Nursing Practice*. 2021;3(2):61-106.
- Jarelnape AA. Application of infection control guidelines among nurses working in surgical units: a cross-sectional study in Sudan. *Med Sci*. 2022;26:0.

- Arafat Soliman A, Sobhy Abd El-Aziz M, Mohammed Sobhy Elsayed D. Infection control measures among nurses at dental clinics. *Journal of Nursing Science Benha University*. 2022;3(2):637-651.
- Arif Z, Butt SA, Pirvani M, Shaikh AA, Niaz AT, Khan S. Knowledge, attitude and practice regarding infection control procedures among dentists of Karachi. *Journal of Advances in Medicine and Medical Research*. 2019;30(8):1-7.
- Alharbi G, Shono N, Alballaa L, Aloufi A. Knowledge, attitude and compliance of infection control guidelines among dental faculty members and students in KSU. *BMC Oral Health*. 2019;19(1):7.
- Mohan S, Priyank H, Kumar G, Viswanath B. Knowledge, attitudes, and practices of undergraduate dental students about sterilization, disinfection, and infection control: a questionnaire-based study. *Cureus*. 2024;16(5).
- Panta G, Richardson AK, Shaw IC, Coope PA. Healthcare workers' knowledge and attitudes towards sterilization and reuse of medical devices in Nepal: A multi-centre cross-sectional survey. *PLoS One*. 2022;17(8):e0272248.
- Razi MA, Debnath S, Qamar S, Kumari P, Singhal A, Minz RS. Awareness, knowledge and practice towards sterilization protocol and infection control among clinical dental students. *Journal of Advanced Medical and Dental Sciences Research*. 2019;7(11):1-5.
- Batool S, Kousar S, Chandio K, Memon KN, Wilson NR. Infection control practices among nurses working at tertiary care hospitals of Quetta, Pakistan. *RADS Journal of Pharmacy and Allied Health Sciences*. 2023;1(1):1-6.
- Liaqat R, Satara A, Bibi S, Shameem M, Perveen N. Assessment of knowledge and practices of nosocomial infection among nurses of Jinnah Hospital Lahore. *NURSEARCHER Journal of Nursing & Midwifery Sciences*. 2025:42-47.
- Khan IU, Mohsin M, Rana AS, Mukhtar L, Abbas MM, Tariq T. Assessment of knowledge, attitude, and practice regarding instrument handling in intraoperative environment among operation theatre staff. *NURSEARCHER Journal of Nursing & Midwifery Sciences*. 2025:03-08.
- Azhar R, Ahsan SH, Rasool S, Jamali S, Hussain B. Knowledge, attitude and practices regarding infection control protocol amongst dental professionals. *Journal of the Pakistan Dental Association*. 2022;31(1).